



Impact of egg retention on walking behavior of *Trichogramma chilonis* (Hymenoptera: Trichogrammatidae)

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Abstract

In the present study effect of egg retention on walking behavior of females of *Trichogramma chilonis* (Hymenoptera: Trichogrammatidae) was investigated under laboratory conditions by using a computer based, Abid's trackmove software. Results revealed that 3 days old wasps showed significant increase in their walking activity for searching host eggs as compared to 1 day and 2 days old wasps respectively.

Keywords: *Trichogramma*, Hymenoptera, Trichogrammatidae, Walking behaviour, Egg retention.

Introduction

Egg parasitoids of genus *Trichogramma* are employed worldwide for biological control of insect pests (Smith, 1996). Searching for their host under natural conditions, long-range dispersal and delayed oviposition is often noticed in *Trichogramma* females (Wright *et al.*, 2001; Kuske *et al.*, 2003). In many field and laboratory studies recorded range of dispersal is even several meters (Brar *et al.*, 2000; McGregor *et al.*, 2000; Mehetre and Salunkhe, 2000; Wang *et al.*, 2000). For host oriented search, dispersal is mainly achieved by walking (Noldus *et al.*, 1991).

Egg retention or delayed oviposition is demonstrated as refusal to oviposit (Monje *et al.*, 1999; Silva and Stouthamer, 1999; Carriere and Boivin, 2001; Hoffmann *et al.*, 2001; Hansen and Jensen, 2002). Dissections and behavioral observations have showed that such females had a lot of mature ovarian eggs but parasitization was blocked at the stage of arrestment and host recognition (Pavlik, 1993; Reznik *et al.*, 1997,

1998). Earlier studies suggest that percentage of time spent in movement by *Trichogramma* females, delaying oviposition due to unavailability of suitable host eggs was slightly higher, than those for ovipositing females with readily available host eggs (Reznik and Umaraova, 1991).

In all previous studies movement activity was only recorded in the presence of host eggs. Thus the increase in time spent during movement could be assessed by time expenditure for parasitization. Besides host, stimuli also had a strong direct influence on the female's behavior (Gardner and Lenteren, 1986; Nordlund, 1994; Schmidt, 1994). Reznik *et al.*, (2001) demonstrated that oviposition by a group of simultaneously emerged *Trichogramma* females was observed to be uniformly distributed in time because of egg retention. Egg retention is thus accompanied with intensive movement activity and this mechanism seems to be even more adaptive when hosts are unavailable.

Relationships between walking behaviour and reproduction has never been investigated in the past. According to Dingle and Winchell (1997) spontaneous movement activity is better option for measure of dispersal. In view of this, present study has been designed to study walking behavior in females of *Trichogramma chilonis* during egg retention without providing host eggs.

Materials and Methods

Females of *Trichogramma chilonis* of age 1, 2 and 3 days were set to walk separately over specially designed grids made on an arena in order to observe their search for hosts (no host eggs were provided). Accuracy of the result depends upon size of grids. Smaller the grid size, accurate will be the results. Grids were numbered in a specific pattern on which computer operates the software (Abid's Trackmove). Grids on which data could be taken easily were selected and a transparent cover slip of 6.6 x 6.7cm with thin boundaries was used to avoid escape of wasps out of the grids. Each day 10 wasps were released singly and observation time for every replication was kept constant i.e. 3 minutes. As the wasps start moving over the grids, software was started and numbers of grids traveled were entered. The whole experiment was carried out under controlled laboratory conditions for temperature, humidity and uniform diet etc.

Results and Discussion

Table 1 shows that all the ten replications for 1 day old wasps have significantly less waking activity than those of 2 and 3 days old wasps

respectively. The total distance covered and velocity attained by 2 days old wasps was higher than those of 1 day old ones and they even stayed for less time in the grids and their velocity without stay points was also greater. Same is the case with 3 days old wasps; they showed more higher velocity and covered more distance than those of 2 days old wasps. Their stay inside the grid was least and the velocity without stay points was maximum as compared to 1 day and 2 days old wasps.

Increased walking activity of *Trichogramma chilonis* wasps on each successive day was observed as to be a reaction for host search for parasitization and it increased with the passage of time due to egg retention resulting pressure build up in ovaries. Therefore, 3 days old wasps showed greater walking activity over 2 days and 1 day old wasps respectively.

Present study clarifies and confirms some queries of the previous studies, e.g. a study on the walking behaviour of *Trichogramma* females suggests that walking behavior of *Trichogramma* species (average speed, percentage of time spent moving etc.) and their movement only depends on environmental conditions, primarily on temperature (Fournier and Boivin 2000; Suverkropp *et al.*, 2001). However in the current study it was observed that physiological state of female can also be important. As all observations were collected under controlled conditions (temperature, humidity, diet, etc.) so difference in velocity and distance covered was observed as direct effect of egg retention. In another study with provision of non preferred hosts among preferred

Table-1: Walking behavior of *Trichogramma chilonis* females observed in relation to egg retention.

Replications (Wasps Released/Day)	Wasps Age	Observation Time	Total Distance Covered	Total Average Velocity	Velocity Without Stay	Total Stay Time
10	1 day	3 minutes	233.4 cm	2.013 cm/sec	3.216 cm/sec	43.29 sec
10	2 days old	3 minutes	274.2 cm	2.366 cm/sec	3.531 cm/sec	39.67 sec
10	3 days old	3 minutes	354.2 cm	2.94 cm/sec	3.804 cm/sec	23.41 sec

ones, it was observed that increase in movement and dispersal in parasitizing *Trichogramma* females was a direct consequence of their search for appropriate host. In accordance to it, present study without provision of any host eggs suggests that increased movement was due to the direct effect of pressure build up in ovaries of female wasps due to egg retention and in result of this, females accelerate their search for host eggs. Each next day this search was increased because the eggs get mature in the ovaries and were needed to oviposit at the earliest.

References

- Abid's Trackmove, Accessed online at <http://www.nifa.org.pk/software.html>.
- Brar, K.S., Khosa, S.S., Sekhon, B.S. 2000. Host searching capacity of laboratory reared and field collected populations of *Trichogramma chilonis* Ishii. *Journal of Biological Control* 14: 29-33.
- Carriere, Y. and Boivin, G. 2001. Constraints on the evolution of thermal sensitivity of foraging in *Trichogramma*: genetic trade-offs and plasticity in maternal selection. *American Naturalist* 157: 570-581.
- Dingle, H. and Winchell, R. 1997. Juvenile hormone as a mediator of plasticity in insect life histories. *Archives of Insect Biochemistry and Physiology* 35: 359-373.
- Fournier, F. and Boivin, G. 2000. Comparative dispersal of *Trichogramma evanescens* and *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae) in relation to environmental conditions. *Environmental Entomology* 29: 55-63.
- Gardner, S.M. and Lenteren, J.C. 1986. Characterization of the arrestment responses of *Trichogramma evanescens*. *Oecologia* 68: 265-270.
- Hansen, L.S. and Jensen, K.M.V. 2002. Effect of temperature on parasitism and host-feeding of *Trichogramma turkestanika* (Hymenoptera: Trichogrammatidae) on *Ephesia kuehniella* (Lepidoptera: Pyralidae). *Journal of Economic Entomology* 95: 50-56.
- Hoffmann, M.P., Ode, P.R., Walker, D.L., Gardner, J., van Nouhuys, S. and Shelton, A.M. 2001. Performance of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) reared on factitious hosts, including the target host, *Ostrinia nubilalis* (Lepidoptera: Crambidae). *Biological Control* 21: 1-10.
- Kuske, S., Widmer, F., Edwards, P.J., Turlings, T.C.J., Babendreier, D. and Bigler, F. 2003. Dispersal and persistence of mass released *Trichogramma brassicae* (Hymenoptera: Trichogrammatidae) in non-target habitats. *Biological Control* 27: 181-193.
- McGregor, R., Caddick, G. and Henderson, D. 2000. Egg loads and egg masses: parasitism of *Choristoneura rosaceana* eggs by *Trichogramma minutum* after inundative release in a commercial blueberry field. *BioControl* 45: 257-268.
- Mehetre, S.T. and Salunkhe, G.N. 2000. Studies on host searching capacity of *Trichogramma pretiosum* Riley, an egg parasitoid of tomato fruit borer. *Journal of Maharashtra Agricultural Universities* 25: 102-103.
- Monje, J.C., Zebitz, C.P.W. and Ohnesorge, B. 1999. Host and host age preference of *Trichogramma galloi* and *T. pretiosum* (Hymenoptera: Trichogrammatidae) reared on different hosts. *Journal of Economic Entomology* 92: 97-103.
- Noldus, L.P.J.J., van Lenteren, J.C. and Lewis, W.J. 1991. How *Trichogramma* parasitoids use moth sex pheromones as kairomones: orientation behaviour in a wind tunnel. *Physiological Entomology* 16: 313-327.
- Nordlund, D.A. 1994. Habitat location by *Trichogramma*. In: Wajnberg, E. Hassan, S.A., (eds.). *Biological control with egg parasitoids*. Wallingford, UK; CAB International: 155-163.
- Pavlik, J. 1993. Variability in the host acceptance of European corn borer, *Ostrinia nubilalis* Hbn. (Lepidoptera, Pyralidae) in strains of the egg parasitoid *Trichogramma* spp. (Hymenoptera, Trichogrammatidae). *Journal of Applied Entomology* 115: 77-84.
- Reznik, S.Ya. and Umarova, T.Ya. 1991. Host population density influence on host acceptance in *Trichogramma*. *Entomologia Experimentalis et Applicata* 58: 49-54.
- Reznik, S.Ya., Umarova, T.Ya. and Voinovich, N.D. 1997. The influence of previous host age on current host acceptance in *Trichogramma*. *Entomologia Experimentalis et Applicata* 82: 153-157.

- Reznik, S.Ya., Umarova, T.Ya. and Voinovich, N.D. 1998. Egg retention in the presence of a host in *Trichogramma* females. *Journal of Applied Entomology* 122: 555-559.
- Reznik, S.Ya., Voinovich, N.D. and Umarova, T.Ya. 2001. Long-term egg retention and parasitization in *Trichogramma principium* (Hymenoptera, Trichogrammatidae). *Journal of Applied Entomology* 125: 169-175.
- Schmidt, J.M. 1994. Host recognition and acceptance by *Trichogramma*. In: Wajnberg, E. and Hassan, S.A., (eds.). *Biological control with egg parasitoids*. Wallingford, UK; CAB International: 165-200.
- Silva, I.M.M.S. and Stouthamer, R. 1999. Do sympatric *Trichogramma* species parasitize the pest insect *Helicoverpa armigera* and the beneficial insect *Chrysoperla carnea* in different proportions? *Entomologia Experimentalis et Applicata* 92: 101-107.
- Smith, S.M. 1996. Biological control with *Trichogramma*: advances, successes, and potential of their use. *Annual Review of Entomology* 41: 375-406.
- Suverkropp, B.P., Bigler, F. and van Lenteren, J.C. 2001. Temperature influences walking speed and walking activity of *Trichogramma brassicae* (Hymenoptera: Trichogrammatidae). *Journal of Applied Entomology* 125: 303-307.
- Wang, Z.Y., Zhou, D.R. and Hassan, S.A. 2000. The dispersal distance and activity rhythm of *Trichogramma ostrinae* in greenhouse. *Acta Phytopythologica Sinica* 27: 17-22.
- Wright M.G., Hoffmann, M.P., Chensus, S.A. and Gardner, J. 2001. Dispersal behavior of *Trichogramma ostrinae* (Hymenoptera: Trichogrammatidae) in sweet corn fields: Implications for augmentative releases against *Ostrinia nubilalis* (Lepidoptera: Crambidae). *Biological Control* 22: 29-37.